ever had the honor to own, classified these abnormal sound aberrations as follows:

1. The audibility of a sound at a distance, and its inaudibility nearer the source of sound.

2. The inaudibility of a sound at a given distance in one direction, while a lesser sound is heard at the same distance in another direction.

3. The audibility at one time at a distance of several miles, while at another the sound can not be heard more than a fifth of the same distance.

4. While the sound is generally heard farther with the wind than against it, in some instances the reverse is the case.

5. The sudden loss of sound in passing from one locality to another in the same vicinity, the distance of the source of sound being the same.

Now, then, the problem can be stated as follows:

To invent or discover a sound-producing apparatus, no more complicated or expensive, or but slightly more so, than those in use, which will be heard uniformly at uniform distances, exception being made in favor of sounds swept away by a heavy wind; or to invent or discover a means of improving present fog signals, as a resonator or reflector, which will so amplify, direct, reflect, or otherwise project the sound that it will not be subject to the aberrations above described, saving that caused by a heavy wind. There is a wide market ready for the invention which solves this problem. In October, 1906, there were four hundred and fifty fog signals in the United States, operated by machinery, not including two hundred and thirty-four whistling and bell buoys. Then there are some thousands of vessels, all with fog signals, not belonging to the United States, and sixty lightships, the fog signals of which are supposed to be as reliable as can be made.

But the problem has another side. It is not enough to warn the mariner of a danger, or point out the course, by a sound; it is necessary to provide him with a means of finding the direction of the sound. Can you locate a cricket?

In a fog the sound seems to come from all directions, unless it is right on top of the vessel, and then the inevitable collision results. The very fact that in spite of warning apparatus of the greatest power collisions frequently occur, shows that some method is needed to definitely locate a sound.

Some vessels now carry a sound-receiving apparatus, consisting of a telephone and microphone immersed in wells in the ship connecting with the water outside, and designed to hear under-water vibrations. There is now an under-water bell on lightships, put overboard in a fog, designed to warn ships so equipped. It is hoped that in time apparatus will be designed by which the sound's direction can be recognized by turning the telephone receiver this way and that until the direction is ascertained by the loudness of the sound. A similar idea is in the invention of Prof. Mayer's "topophone," in which the sound wave is defined by means of resonators. But the apparatus requires the resonators to be attuned to the source of sound and an undistorted sound wave, and is not yet practicable.

The accompanying illustrations show some of the sound signal apparatus now in use. The Daboll trumpets are blown by compressed air, the power being furnished by an oil engine. One of the illustrations shows the interior of a typical first-order siren station. Although an ear-splitting sound may be produced from this steel throat, capable of carrying thirty miles under favorable conditions, the sound may be inaudible just when it is most needed, due to the causes suggested in the first part of this paper.

THE MOST POWERFUL EXPRESS LOCOMOTIVE EVER BUILT.

(*Continued from page* 528.)

By the courtesy of the Pennsylvania Railroad Company, we present, for comparison with their latest locomotive, a photograph of a diminutive engine, which has the distinction of having been the first to haul a train over the lines now owned by this company. The smaller engraving represents the celebrated "John Bull," which is now in the National Museum at Washington. It was the first engine used on the Camden & Amboy Railroad, which is now a part of the Pennsylvania system; and it was built in England in 1830 by Stephenson & Co., of Newcastle-on-Tyne, to the order of Robert L. Stevens, president of the railroad. It reached Bordentown, N. J., in August, 1831. The engine was originally named "Stevens," but on its arrival in this country the railroad company renamed it "John Bull." It was put in service November 12, 1831, at Bordentown, N. J., at the place where the Railroad Monument now stands.

The leading dimensions are as follows: Weight about 10 tons; boiler, 3 feet 6 inches diameter; cylinders, 9 inches diameter by 20 inches stroke. Four coupled wheels 4 feet 6 inches diameter, with cast-iron hubs and locust wood spokes and felloes. Tires of wrought iron ¾ inch thick; sixty-two tubes, 7 feet 6 inches long by 2 inches diameter. Furnace 3 feet 7 inches long by 3 feet 2 inches high (for burning wood). Heating surface of tubes, 213 square feet; of firebox, 36 square feet. Total heating surface, 249 square feet. The firebox was of the dome or Bury pattern. The reversing gear was complicated, the two eccentrics being secured to a sleeve or barrel, which fitted loosely on the crank shaft.

Soon after the engine arrived, the Camden & Amboy mechanics made the following changes and additions: As the railroad curves were very sharp, the coupling rods and cranks were removed and a lateral play of 1½ inches given to the leading axle, to which a cow-catcher was connected. The wooden wheels were replaced by cast-iron wheels. The dome was moved forward to the former manhole and the boiler lagged with wood. A bell was placed on the boiler and a headlight on the smokebox. A new tender was subsequently built, having a small cab on the rear for the accommodation of a brakeman, who, if anything went wrong with the cars, could signal the engine driver to stop. A cab and a large wood-burning chimney were subsequently added, but both these were removed some time before the engine was placed in the United States National Museum.

According to Mr. Herbert T. Walker, a well-known authority on locomotive history, this was the first engine equipped with a bell, headlight, and cowcatcher, although bells were used on English locomotives as far back as 1827.

This remarkable locomotive was exhibited at the Philadelphia Exposition of 1876, and again at the Chicago Exposition of Railway Appliances in 1883, and lastly, at the Columbian Exposition of 1893. Leaving New York city under steam April 17, 1893, it hauled "the John Bull train" of two cars 912 miles, without assistance, to Chicago, arriving April 22, and meeting with a continued ovation over the entire route. It formed part of the Pennsylvania Railroad's Company's exhibit, and was one of the great attractions of the World's Fair, carrying over fifty thousand passengers over the exhibition tracks in the terminal station yard. The engine left Chicago again under steam December 5, 1893, coming east over the Pennsylvania lines *via* the Southwest system to Pittsburg, and through Altoona, Harrisburg, and Baltimore to Washington, arriving there December 13, 1893. This was a very good performance for a locomotive sixty-two years of age. It was then returned to the museum at Washington, where it will remain permanently.

THE MAGNITUDE OF VICTORIA FALLS.

Oozing out of a black, boggy depression in the heart of Southern Africa is a sluggish, muddy stream which wends its way southward, very leisurely at first, but it soon grows rapidly in size and strength until it pours into the Indian Ocean, 1,650 miles away, fourth in rank among the mighty rivers of Africa. About 700 miles from its source, and just beyond the cataracts of Mololo, the Zambesi, joined by the waters of the Kwando River, spreads out into what might be termed a lake about six miles long and over a mile in width. This lake is studded with islands and the surface is very smooth, the vegetation along the banks being perfectly mirrored in the placid water. Strange to say, the lower end of this lake is marked not by a shore line nor by the slightest narrowing of its surface, but by an abrupt fall beside which our much-vaunted Niagara is a mere pygmy. It is an entire lake that takes the plunge, and not merely a river.

A comparison of Niagara and Victoria Falls is pictured in the front-page illustration, which shows at a glance how vastly greater is the African falls. At Niagara the river takes a plunge of 168 feet, but the Zambesi falls sheer 400 feet. The crest of Victoria Falls is over a mile long—5,808 feet, to be exact—whereas the American Fall at Niagara measures but 1,060 feet, and the Horseshoe Fall is only 1,230 feet across, or 3,010 feet as measured along the curve. To illustrate the magnitude of the African waterfall, we have depicted against it the skyline of New York from Battery Park to Worth Street. Not a building projects above the crest of the falls excepting only the tower of the Singer Building, which is now in process of erection. To be sure, in comparing Niagara with Victoria, it must be said in favor of the former that the Horseshoe Fall presents an unbroken crest, while the edge of the Victoria is divided by numerous islands into stretches which nowhere exceed 600 feet. At the center is Livingstone Island, and to the left, as you look up stream, is the main fall, while at the right of the island is the Rainbow Fall. Buka Island separates the main fall from the Cascade or Devil's Creek.

Fully as remarkable as the falls themselves is the peculiar formation of the chasm into which the waters pour. Facing the falls, and separated from it by a space of less than 300 feet in width, is a vertical wall of rock presenting a barrier to the flow of water which is unbroken except for a gorge near the center a little over 300 feet wide. It seems as if this wall, which at one time undoubtedly formed the lower terminal of the lake, had been moved bodily back by some giant hand, leaving a deep, narrow fissure into which the waters of the lake fall. Since there is but one outlet from this fissure, and that only 300 feet wide, the depth of water in the gorge must be exceedingly great. The peculiar geological formation may be said to cause the lake or river to flow first on end over the falls, and then on edge through the gorge.

The water pours into the fissure amid clouds of spray, with a deafening roar which may be heard for miles. This has given rise to its native name, Mosi-oa-Tounya, or the Thunder Sounding Smoke. For the same reason Niagara was called by the aborigines the Abode of the Spirit of Thunder. Bearing out the belief of the red man, his pale-faced brother has succeeded in drawing the lightning from this Thunder Spirit. Similarly, the white man expects soon to draw the fire from the Thunder Sounding Smoke, and use it to operate the machinery of the Rand gold fields. In keeping with the size of this giant waterfall, as outlined in the Scientific American of December 22, 1906, the Victoria power station, when completed, will have an output of 250,000 horse-power at the enormous pressure of 150,000 volts, and will transmit its power 600 miles, or nearly three times as far as any system now in operation.

The Sealed Bonnet Contest of the Automobile Club of America.

What proved to be one of the most interesting as well as successful automobile competitions ever held in the vicinity of New York city was that conducted by the Automobile Club of America during the last four days of last week, and which was known as a "Sealed Bonnet Contest."

In this contest the bonnets, radiators, gear boxes, tools, etc., were sealed and were not allowed to be touched throughout the total distance of 600 miles, which was covered in daily runs out and back of 150 miles each. The first and last day's runs were to Patchogue, L. I., and those on the second and third days were to Danbury and West Haven, Conn., respectively. Almost the total distance was over macadamized roads, but as the contestants were favored with fair weather, this made no particular difference.

No less than 47 cars started in the test on Wednesday, June 19, and 42 of these finished with a perfect score on the afternoon of Saturday, June 22. A Stoddard-Dayton runabout, entered by a private owner, dropped out the first day, owing to the replacing of the nut which holds on the steering wheel. The second day's run was completed with the loss of but one more contestant—the Columbia gasoline-electric touring car—which was obliged to open its bonnet in order to replace a broken valve spring. Three contestants were arrested for speeding at Mt. Kisko by a constable with a rope which he stretched across the road. In view of the fact that the club stationed men with flags at the entrance and exit of each village, thus cautioning the contestants to obey the speed limit under penalty of disqualification if they did not, this attempt to mulct the autoists by the Mt. Kisko authorities should not be passed over lightly. No competition of this character more devoid of racing has ever been held, and the Club will doubtless not allow the constable and justice of the village in question to put upon the contestants the stigma of speeding because of some very slight technical violation.

The cars were divided into three classes according to price. The price limits of these classes were: Class A, $3,000 and over; class B, $1,500 to $3,000; class C, $1,500 and under. Runabouts in class A were required to cover 175 miles a day instead of 150. The average speeds required of the three classes were 17, 15, and 13 miles an hour respectively.

All stops were recorded, and the length of each stop was added to the running time. Tire repairs were the only repairs permissible, and the time taken in making these had to be added to the running time of the cars. A notable feature of the various runs was the fact that there was little or no tire trouble; only two or three cars each day were delayed on this account. The fact that the runs were made over first-class macadamized roads doubtless accounts for the lack of tire trouble. Nevertheless, it is quite remarkable that out of nearly half a hundred cars of all sizes and weights, there should be such a small percentage delayed on account of tires in a series of runs aggregating 600 miles in length.

Altogether there were thirty-seven touring cars and ten runabouts engaged in the competition. Among these were an Aerocar, two American Mors, two Berliets, three Corbins, one Continental, one Columbia, two Darracqs, one Deere, one DeLuxe, an Elmore, a Glide, a Haynes, a Jackson, two Knoxes, four Locomobiles, two Loziers, two Mathesons, two Maxwells, three Moras, an Oldsmobile, a Pierce-Arrow, a Pope-Hartford, a Pope-Toledo, a Royal Tourist, a Rolls-Royce, three Stoddard-Daytons, one Studebaker, a Welch, and two Whites.

It is certainly remarkable that so many standard machines of both domestic and foreign manufacture were able to go through so severe a test with a perfect score; and their performance in this test should do much to influence intending purchasers, who have had

impressed upon them heretofore by their well-meaning automobilist friends the idea that it often costs more to keep a car and run it than the original price of the car itself.

With the test just cited as a sample, the Chicago Motor Club has decided to conduct a similar test on June 28. Three classes are provided for touring cars, and a separate class for roadsters or high-powered runabouts. There will be but one prize in each class, and the car having the least penalization will win this. In this contest, each time the engine is stopped there will be a penalization of 25 points. The bonnet and coil of each car will be sealed, and a penalization of 50 and 25 points respectively will be made for the breaking of these seals. Five points penalization will be given for each minute or fraction thereof spent in making repairs, adjustments, or replacements. Putting water in the radiator will also be penalized. All cars having the engines underneath must be provided with mud aprons, which will also be sealed. There will be no penalties for repairing tires, but the contestants will have to make up any time lost in this manner within a control. A leeway of ten minutes is allowed at each control. There will be five checking stations, and the total distance is 131.6 miles.

In addition to the sealed bonnet contest just mentioned, California automobilists are to have a two days' endurance run from Los Angeles to San Diego on June 27 and 28, and the Quaker City Motor Club is to conduct the reliability run from Philadelphia to Wildwood, New Jersey, July 3. The race meet will be held at the latter place on the Fourth.

INAUGURATION OF WORK ON THE CATSKILL NEW YORK WATER SUPPLY.

On June 21, on the side of one of the mountains to be intersected by the aqueduct, Mayor McClellan cut the first sod of what is probably the greatest municipal engineering work ever undertaken in the history of the world—the Catskill water supply for New York city. At the invitation of the New York Board of Water Supply some three hundred guests, including besides the Mayor, the Comptroller, the Corporation Counsel, the State and Civil Service Commissions, and representatives of various prominent institutions in this city, were taken by steamer to Cold Spring, on the eastern bank of the Hudson River, and were then driven some three miles back into the mountains to the valley of what is known as Indian Creek. Here, after appropriate ceremonies, a silver spade was presented by Commissioner Charles M. Chadwick to the Mayor, who, after turning the sod, announced, "Now I, the Mayor, in the name of the people of New York, declare this work begun."

It was fitting that the work of actual construction should be thus inaugurated by Mayor McClellan; for it is to his appreciation of the grave condition which threatened New York with the terrors of a water famine, and to the energetic and masterly way in which he has used all his influence to push the work through to its present stage, that the present and future citizens of New York will be indebted for this, its most important municipal undertaking. The magnitude of the work will be understood when it is stated that its estimated total cost of $162,000,000 is not far short of the total estimated cost of the Panama Canal. Next to the Mayor, credit should be given to the Commissioners, President J. Edward Simmons, and his fellow Commissioners, Charles M. Chadwick and Charles S. Shaw, for the enthusiasm and energy which they have displayed, and the excellent results achieved during the brief period in which they have been in office. The speech of President Simmons was of an unusually high order, and the motives and purpose of the work were summarized in a passage which we here quote:

"Why do four millions of Americans who compose the greatest municipality of the New World contribute without a murmur all the treasure required for this gigantic enterprise? The answer comes spontaneously to our lips. It has been demanded and ordered by the people for the people.

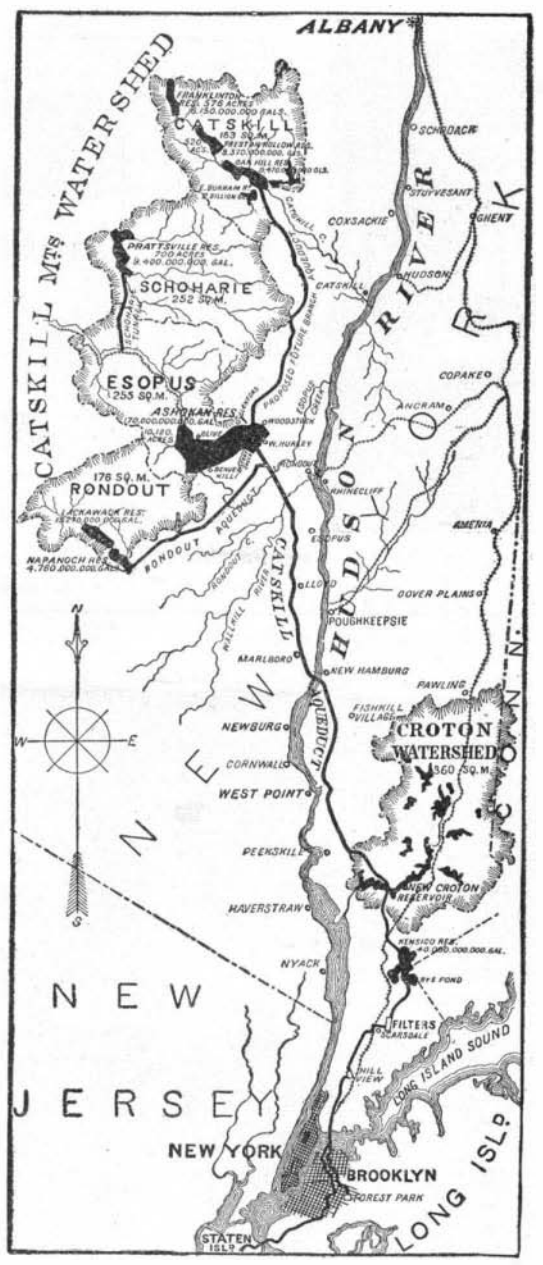
"This mighty aqueduct will take away from no man anything that is needful to him. It will bring the purest and most healthful of all drinks to myriads of our fellow-citizens, both in the present and the future. It will bring to their homes the means of cleanliness and happiness. It will be a safeguard to the household goods of the poor and to the merchandise of the captains of industry."

After the ceremony of turning the first spadeful of earth the Mayor said:

"When I took office on January 1, 1904, I found myself confronted with a possible water famine, and with nothing practical done for its avoidance. The imminence of the peril was appreciated by the few who had studied the matter, but the public at large did not understand its seriousness, nor was there any public sentiment in favor of its speedy solution. Some preliminary work had been done and done well, but that was all. My administration found it necesary to do three things before a new water supply system could be actually undertaken. First, it was necessary to provide an additional borrowing capacity to meet the expenses of the undertaking, by means of a constitutional amendment which had passed the Legislature, but had not been submitted to the people. Second, it was necessary to enact legislation so as to make the powers of the local authorities certain. And third, and most important, it was necessary to arouse public opinion so that the first two obstacles could be removed.

"As the years merge in the decades and the decades in the centuries, when time has thrown its kindly veil over the bickerings and the differences and the quarrels which seem so much to us and are after all so futile and so petty, when friend and enemy, traducer and traduced have passed away, when our very names shall have been forgotten, when this great work conceived in honesty, begun in honesty and completed, God willing, in honesty, shall be administering to the health and happiness of millions yet to come, then God grant that those who shall see it may say: 'It does not matter how they were called who did this thing, or who they were, or what they were, it is enough that they did their duty.'"

The sod was cut on a strip of two and one-half acres



MAP OF NEW YORK CITY'S PROPOSED NEW WATER SUPPLY.

of land which has the distinction of being the first land bought by the city for the new aqueduct.

In selecting a new source of water supply, the engineers realized that the conditions surrounding New York city were exceedingly difficult. To the east it is shut in by the Atlantic Ocean; to the west it is excluded by the laws of New Jersey from tapping any of the water sources of that State. The excellent supply which might have been drawn upon from the sources of the Housatonic River was shut out of consideration because of the location of that river in the State of Connecticut; and hence the city has been driven by its geographical and legal restrictions to the splendid sources of supply which lie in the Catskill Mountains. This water supply is not only abundant, but the water is of most excellent quality. By reference to the accompanying map, it will be seen that four separate districts are to be drawn upon. The first of these is what is known as the Esopus Creek watershed, which has an area of 255 square miles. Its waters are to be impounded by the construction of a great dam 220 feet in height across the valley of the Esopus, at the Olive Bridge site. The dam will create the Ashokan reservoir, 12 miles in length and 2½ miles in width, with a capacity at full level of 170,000,000,000 gallons, and capable of supplying 250,000,000 gallons of water per day. From the dam a huge aqueduct 17½ feet in its largest diameter will be built, partly by the cut-and-cover method and partly in tunnel, which will extend to the westerly bank of the Hudson River at a point between Cornwall and West Point.

It was originally intended to carry the aqueduct in tunnel below the Hudson River at New Hamburg, but the preliminary borings at this and other sites proved that it would be difficult to find a rock sufficiently free from fissures and other imperfections to render it suitable to withstand the enormous pressure of the water at the depth below the river at which it would have to be carried. Borings are now being made near Cornwall at a site where geologists assured the engineers that it would be possible to find a thoroughly sound and suitable rock. The aqueduct passes through the mountain and reaches the westerly slope of the Hudson River at an elevation of 400 feet above tide level. Here a vertical shaft will be sunk until a depth probably of 700 feet below the river surface or 1,000 feet below the level of the aqueduct is reached. The tunnel will then pass beneath the river to connect with another vertical shaft of almost equal depth on the easterly bank of the river. From this point it will be constructed through the mountains until it reaches the new Croton reservoir. Here connections will be made to enable the water to be drawn directly from the Ashokan reservoir into the Croton reservoir, with a view to augmenting the Croton supply until the whole aqueduct from Ashokan to New York city shall have been completed.

From the Croton reservoir the aqueduct will be continued south to Kensico reservoir, which will be enlarged to include Rye Pond, and form an auxiliary storage reservoir at an elevation of 355 feet above mean tide, capable of containing 25,000,000,000 gallons, or sufficient to supply the city at the rate of 500,000,000 gallons for a period of fifty days. About four miles south of Kensico, at Scarsdale, there will be built a large filtering plant, and six miles to the south of this will be another storage reservoir at Hill View. With these two auxiliaries or emergency reservoirs provided, the city will be secured against any sudden interruption of its supply through failure of the 69 miles of aqueduct lying to the north of them.

By the construction of a tunnel of 200,000,000 gallons daily capacity below the East River, Brooklyn and Staten Island will be provided with a supply of 100,000,000 gallons daily, and this aqueduct will terminate in a large reservoir to be constructed in Forest Park. From the point where this tunnel reaches the shores of Long Island, a line of 20,000,000 gallons capacity will be built through Brooklyn and below the Narrows for the supply of Staten Island.

The rate of growth of Greater New York is so rapid that it cannot be many years before the watersheds of the Rondout, the Schoharie, and ultimately of the Catskill rivers will, in turn, be brought into service. The Rondout watershed covers 176 square miles, and would be capable of yielding 130,000,000 gallons daily. This water will be stored in what will be known as the Mapanoch reservoir, from which its waters will be led by an aqueduct into the main Catskill aqueduct a couple of miles below the Ashokan reservoir. Later, the Schoharie watershed will be brought into service by the construction of the Prattsville reservoir, its waters being brought into Esopus Creek by means of a tunnel through the divide. Lastly, the Catskill water will be impounded in several reservoirs located along that stream, and brought into the Ashokan reservoir by an aqueduct whose location is shown on the accompanying map. Altogether, when the whole scheme is completed, New York city will have at command over 700,000,000 gallons daily water supply from the Catskill Mountain watershed, in addition to the 375,000,000 gallons already available in the Croton watershed.

The Current Supplement.

More than 10,000 men are in daily attendance at the largest railway university in the United States. The university is described by Frederic Blount Warren in the current SUPPLEMENT, No. 1643. "False Back Repetition Casting" is the title of an article which will interest the amateur founder. Some practical tests of rubber are given. Several forms of telegraph railroad signaling systems have been proposed, and a number of tests have been carried out. The most recent of these systems, invented by Frank W. Prentice, is described. Walter F. Reid tells how to use waste India rubber. "Bacteria in Cheesemaking" is the title of an essay by Prof. Herbert W. Conn. "The Amateur's Foundry" is simply described by Walter J. May, a well-known English expert. If the same region of the sky is photographed at two epochs, the comparison of the photographs in the stereoscope at once shows what stars have altered in brightness in the interval, for in the photographs the diameters of the star disks vary according to the brightness of the star. This method is described in the current SUPPLEMENT by Dr. Max Wolf, the well-known Director of the Heidelberg University Observatory. The maintenance of the equilibrium in aeroplanes is a subject of vital importance to the aeronaut. Robert W. Goddard shows how the gyroscope may be used for balancing and steering aeroplanes.

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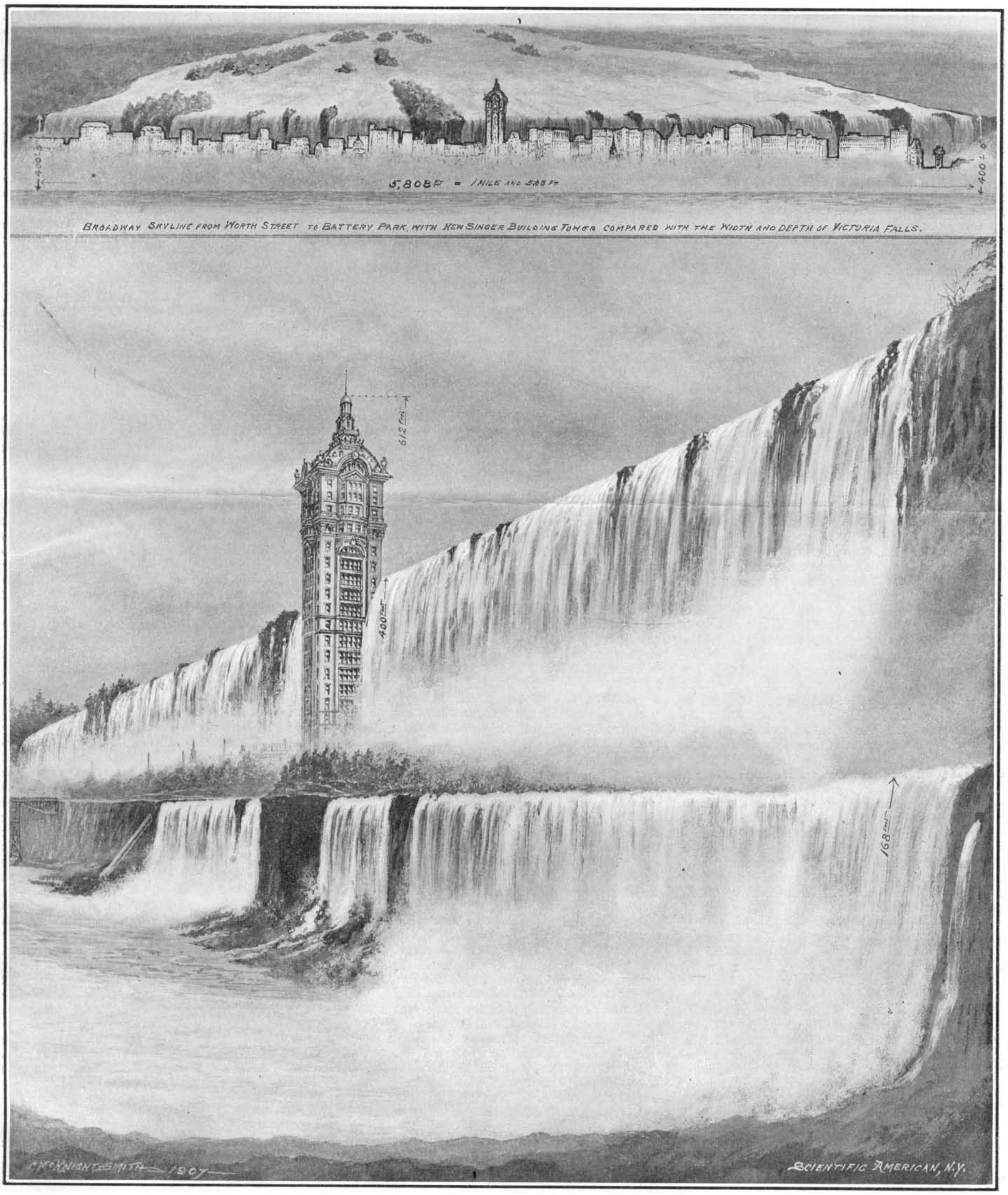

Comparison of Victoria Falls (400 Feet High) With Niagara Falls (168 Feet High) and With the Sky Line of New York. Only the Singer Building's Tower Rises Above the Crest.

VICTORIA FALLS AS COMPARED WITH NIAGARA.—[See page 530.]